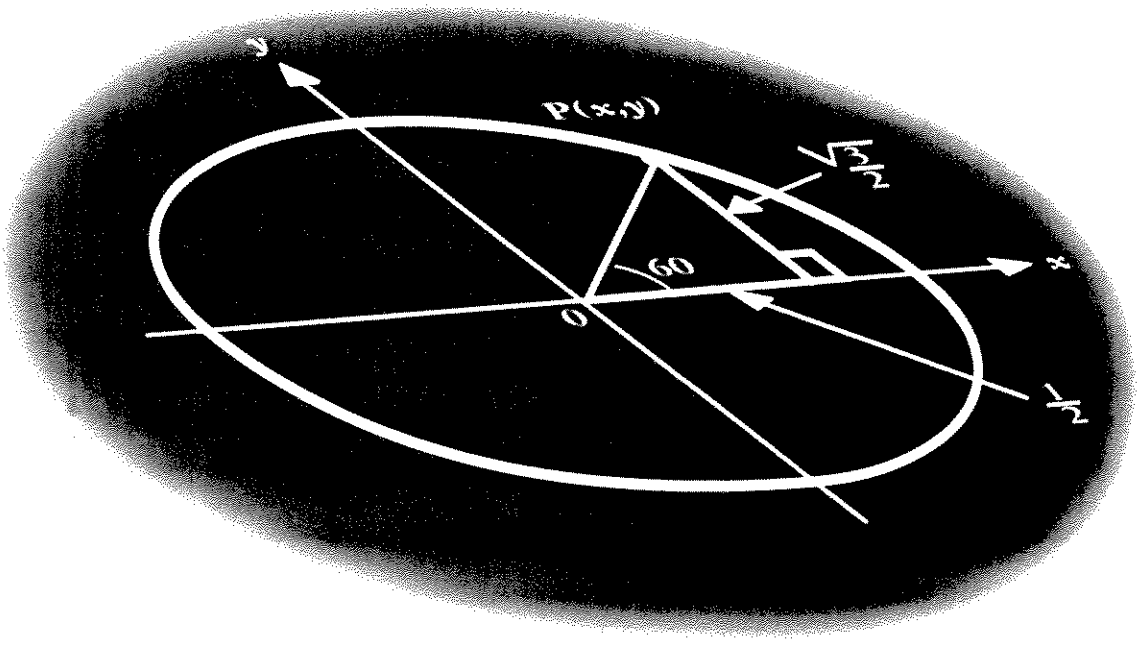
KEEP YOUR EYE ON THE BALL

Curve Balls, Knuckleballs, and Fallacies of Baseball

Revised and Updated

"Provides the layman with entertaining explanations of some of baseball's most cherished assumptions."

—David G. Baldwin, Ph.D., Enterprise Data Solutions



Robert G. Watts/A. Terry Bahill

Interior Design by Blake Logan

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Ruth reportedly responded, "I had a better year." Home run hitters generally began having much better years (financially) than those who merely hit singles for higher averages. As Meany said, "The money's in the big end of the bat." When someone told former Pittsburgh Pirate first baseman and power hitter Ralph Kiner that he could raise his batting average by choking up on the bat, Kiner replied, "Cadillacs are down at the end of the bat." Hitters are concentrating more on hitting home runs. As is the case in other sports, diet and other factors have also led to healthier, stronger players.

The Best Bat Weight: From the Principles of Physics

The bat might have played at least as important a role as the ball in the home run explosion. According to statistics compiled by Hillerich and Bradsby, manufacturers of the Louisville Slugger bat, the average weight of bats used by top players decreased from about 40 ounces in the 1920s to about 32 ounces in the 1950s[4] and has kept this value to the present day. Home run production increased dramatically while the bat weight was dropping.

Baseball players, for example, Babe Ruth, have used bats as heavy as 54 ounces, but physicists have said that the optimal bat weight is only 15 ounces.[2,3] Because no one really knew what bat weight was best, over the years there has been a lot of experimenting with the bat. Most of this experimentation was illegal, because the rules say that (for professional players) the bat must be made from one solid piece of wood. To make the bat heavier, George Sisler, who was elected to the Hall Fame in 1939, pounded Victrola phonograph needles into his bat barrel and in the 1950s Ted Kluszewski of the Cincinnati Reds hammered in tenpenny nails. To make the bat lighter, many players have drilled a hole in the end of the bat and filled it with cork.[5] Detroit's Norm Cash admits to using a corked bat in 1961 when he won the American League batting title by hitting .361. However, the corked bat may have had little to do with his success, because he presumably used a corked bat the next year when he slumped to .243. Some players have been caught publicly using doctored bats. In 1987 Houston's Billy Hatcher hit the ball and his bat split open spraying cork all over the infield.

as well as our intuition, tell us that such a bat would simply be knocked from a batter's hands. Surely there is an optimum bat weight between these two extremes. But optimum in what sense?

Momentum effects associated with the collision itself tell us that for a given speed, we need a massive bat. We also know, however, that the smaller the bat, the higher the bat speed that can be obtained. The speed with which a particular batter can swing his weapon depends on how much energy he can put into his swing. To resolve our conflict, and to learn more about the optimum bat and the optimum swing, we need to stop looking at only the bat and the ball. We must now consider the human being swinging the bat.

The Best Bat Weight: From the Principles of Physics and Physiology

The speed of a baseball after its collision with a bat depends on many factors, not the least of which is the weight of the bat. One professional baseball team (St. Louis Cardinals) says the weight of the bat is determined by "the player's personal preference," while another (New York Yankees) says, "Each individual player determines the style of bat he prefers." These players have very little real scientific data to help them support their preferences. In this section, we present data to help an individual player to decide if his or her preference is the most effective bat weight. Knowing the ideal bat weight can eliminate time-consuming and possibly misleading experimentation by ballplayers.

To find the best bat weight we must first reexamine the conservation of momentum equations for bat-ball collisions. For the science of baseball, the distinction between mass and weight is not critical, and so we will substitute weight for mass in the equation for the conservation of momentum to produce

$$w_1 v_{1b} + w_2 v_{2b} = w_1 v_{1a} + w_2 v_{2a}$$

Keep in mind that we are assuming the weight of the batter's arms has no effect on the collision (this may be an important assumption). We want to solve for the ball's speed after its collision with the bat, called the *batted-ball-speed*, but first we should eliminate the bat's speed after the collision, because it is not easily measured. We can use the equation for the coefficient of restitution to solve for v_{2a}, substitute the result into the equation